

WHAT IS CLAIMED IS:

1. A Faraday rotator for rotating a polarization plane of light transmitting therethrough by a magnetic field,

wherein Faraday rotation is caused by a first magnetic field applied to a magneto-optical crystal of the Faraday rotator, a Faraday rotation angle is controlled by a second magnetic field over an entire variable strength range of the second magnetic field, and the magneto-optical crystal is positioned in such a manner that a direction of a combined magnetic field of the first and second magnetic fields, except for a direction of the first magnetic field, is variable intermediately between an easy magnetization axis and hard magnetization axis of the magneto-optical crystal.

2. The Faraday rotator according to claim 1, wherein the Faraday rotator is associated with a driving circuit, the driving circuit comprising an electromagnet including a magnetic core having a coil wound thereon and adapted to generate the second magnetic field, a voltage source whose output voltage has no temperature coefficient and a series resistor connected in series with the voltage source, or comprising the electromagnet, a current source whose output current has no temperature coefficient and a parallel resistor connected in parallel with the current

source.

3. The Faraday rotator according to claim 2,
wherein the coil comprises a wire made of copper or copper
5 compound.

4. The Faraday rotator according to claim 2,
wherein the series resistor or the parallel resistor
comprises a resistor made of Nichrome.

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5. The Faraday rotator according to claim 2,
wherein the series resistor or the parallel resistor
comprises a variable resistor.

15 6. The Faraday rotator according to claim 2,
wherein the series resistor has a resistance of zero or
the parallel resistor has a resistance of infinity.

7. A variable optical attenuator for variably
20 controlling a level of an optical signal, comprising:

a polarizer made of a birefringent crystal and
arranged on an incoming side of the optical signal;

an analyzer made of a birefringent crystal and
arranged on an outgoing side of the optical signal; and

25 a Faraday rotator inserted between the polarizer
and the analyzer, wherein Faraday rotation is caused by a
first magnetic field applied to a magneto-optical crystal

of the Faraday rotator, a Faraday rotation angle is controlled by a second magnetic field over an entire variable strength range of the second magnetic field, and the magneto-optical crystal is positioned in such a manner that a direction of a combined magnetic field of the first and second magnetic fields, except for a direction of the first magnetic field, is variable intermediately between an easy magnetization axis and hard magnetization axis of the magneto-optical crystal.

8. The variable optical attenuator according to claim 7, wherein the Faraday rotator is associated with a driving circuit, the driving circuit comprising an electromagnet including a magnetic core having a coil wound thereon and adapted to generate the second magnetic field, a voltage source whose output voltage has no temperature coefficient and a series resistor connected in series with the voltage source, or comprising the electromagnet, a current source whose output current has no temperature coefficient and a parallel resistor connected in parallel with the current source.

9. A variable optical attenuator for variably controlling a level of an optical signal, comprising:

a polarizer made of a birefringent crystal and arranged on an incoming side of the optical signal;

a reflector element for reflecting the optical

signal; and

a Faraday rotator inserted between the polarizer and the reflector element, wherein Faraday rotation is caused by a first magnetic field applied to a magneto-optical crystal of the Faraday rotator, a Faraday rotation angle is controlled by a second magnetic field over an entire variable strength range of the second magnetic field, and the magneto-optical crystal is positioned in such a manner that a direction of a combined magnetic field of the first and second magnetic fields, except for a direction of the first magnetic field, is variable intermediately between an easy magnetization axis and hard magnetization axis of the magneto-optical crystal.

10. The variable optical attenuator according to claim 9, wherein the Faraday rotator is associated with a driving circuit, the driving circuit comprising an electromagnet including a magnetic core having a coil wound thereon and adapted to generate the second magnetic field, a voltage source whose output voltage has no temperature coefficient and a series resistor connected in series with the voltage source, or comprising the electromagnet, a current source whose output current has no temperature coefficient and a parallel resistor connected in parallel with the current source.

11. An optical shutter for shutting down an

optical output, comprising:

a polarizer made of a birefringent crystal and arranged on an incoming side of an optical signal;

an analyzer made of a birefringent crystal and
5 arranged on an outgoing side of the optical signal;

a Faraday rotator inserted between the polarizer and the analyzer, wherein Faraday rotation is caused by a first magnetic field applied to a magneto-optical crystal of the Faraday rotator, a Faraday rotation angle is
10 controlled by a second magnetic field over an entire variable strength range of the second magnetic field, and the magneto-optical crystal is positioned in such a manner that a direction of a combined magnetic field of the first and second magnetic fields, except for a direction of the
15 first magnetic field, is variable intermediately between an easy magnetization axis and hard magnetization axis of the magneto-optical crystal; and

a driving circuit for switching a current value thereof between a value at which an amount of optical
20 attenuation is at a minimum and a value at which the amount of optical attenuation is at a maximum.

12. The optical shutter according to claim 11, wherein the driving circuit comprises an electromagnet
25 including a magnetic core having a coil wound thereon and adapted to generate the second magnetic field, a voltage source whose output voltage has no temperature coefficient

and a series resistor connected in series with the voltage source, or comprises the electromagnet, a current source whose output current has no temperature coefficient and a parallel resistor connected in parallel with the current
5 source.

13. An optical shutter for shutting down an optical output, comprising:

a polarizer made of a birefringent crystal and
10 arranged on an incoming side of an optical signal;

a reflector element for reflecting the optical signal;

a Faraday rotator inserted between the polarizer and the reflector element, wherein Faraday rotation is
15 caused by a first magnetic field applied to a magneto-optical crystal of the Faraday rotator, a Faraday rotation angle is controlled by a second magnetic field over an entire variable strength range of the second magnetic field, and the magneto-optical crystal is positioned in
20 such a manner that a direction of a combined magnetic field of the first and second magnetic fields, except for a direction of the first magnetic field, is variable intermediately between an easy magnetization axis and hard magnetization axis of the magneto-optical crystal; and

25 a driving circuit for switching a current value thereof between a value at which an amount of optical attenuation is at a minimum and a value at which the

amount of optical attenuation is at a maximum.

14. The optical shutter according to claim 13,
wherein the driving circuit comprises an electromagnet
5 including a magnetic core having a coil wound thereon and
adapted to generate the second magnetic field, a voltage
source whose output voltage has no temperature coefficient
and a series resistor connected in series with the voltage
source, or comprises the electromagnet, a current source
10 whose output current has no temperature coefficient and a
parallel resistor connected in parallel with the current
source.

15. A variable optical equalizer for equalizing a
15 gain, comprising:

a polarization separator element for separating
input light into ordinary light and extraordinary light;

a polarization plane coincidence control element
for causing polarization planes of the two separated beams
20 of light to coincide with each other;

a first Faraday rotator for rotating a
polarization angle of the two beams of light whose
polarization planes have been made to coincide with each
other, wherein Faraday rotation is caused by a first
25 magnetic field applied to a magneto-optical crystal of the
first Faraday rotator, a Faraday rotation angle is
controlled by a second magnetic field over an entire

variable strength range of the second magnetic field, and the magneto-optical crystal is positioned in such a manner that a direction of a combined magnetic field of the first and second magnetic fields, except for a direction of the first magnetic field, is variable intermediately between an easy magnetization axis and hard magnetization axis of the magneto-optical crystal;

a wavelength-dependent transmittance characteristic varying element for imparting a wavelength-dependent transmittance characteristic corresponding to the rotation of the polarization angle;

a second Faraday rotator for causing a rotation of the polarization angle which is opposite in direction to the rotation of the polarization angle caused by the first Faraday rotator and which has an absolute value equal to that of the rotation of the polarization angle caused by the first Faraday rotator, wherein Faraday rotation is caused by a first magnetic field applied to a magneto-optical crystal of the second Faraday rotator, a Faraday rotation angle is controlled by a second magnetic field over an entire variable strength range of the second magnetic field, and the magneto-optical crystal is positioned in such a manner that a direction of a combined magnetic field of the first and second magnetic fields, except for a direction of the first magnetic field, is variable intermediately between an easy magnetization axis and hard magnetization axis of the magneto-optical

crystal;

a phase difference control element for compensating for a phase difference between P-polarized light and S-polarized light caused in the wavelength-dependent transmittance characteristic varying element;
5 and

a polarization plane restoration element for combining the ordinary light and the extraordinary light.

10 16. The variable optical equalizer according to claim 15, wherein the first and second Faraday rotators are each associated with a driving circuit, the driving circuit comprising an electromagnet including a magnetic core having a coil wound thereon and adapted to generate
15 the second magnetic field, a voltage source whose output voltage has no temperature coefficient and a series resistor connected in series with the voltage source, or comprising the electromagnet, a current source whose output current has no temperature coefficient and a
20 parallel resistor connected in parallel with the current source.